UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/727,629	12/05/2003	In-kyu Park	030681-457	9103

21839 7590 03/23/2006

BUCHANAN INGERSOLL PC
(INCLUDING BURNS, DOANE, SWECKER & MATHIS)
POST OFFICE BOX 1404
ALEXANDRIA, VA 22313-1404

EXAMINER	
PRENDERGAST, ROBERTA D	
ART UNIT	PAPER NUMBER
2628	

DATE MAILED: 03/23/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/727,629	PARK ET AL.	
	Examiner	Art Unit	
	Roberta Prendergast	2671	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-33* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-3,5-8,16-18,21-25,28 and 30-33* is/are rejected.

7)☒ Claim(s) *4,9-15,19,20,26,27 and 29* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *05 December 2003* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 4/15/04; 6/21/04.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Drawings

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description: Fig. 16(element 1610) and Fig. 21(element 2140). Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the examiner does not accept the changes, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 2, 6 and 30 are rejected under 35 U.S.C. 102(b) as being anticipated by Prevost et al. U.S. Patent No. 5123084.

Referring to claim 1, Prevost et al. teaches a method of encoding three-dimensional object data, which is comprised of point texture data, voxel data, or octree structure data, the method comprising generating three-dimensional object data having a tree structure in which nodes are attached labels indicating their types (Figs. 1-2(A-D); column 1, lines 35-40; columns 3-4, lines 51-3, i.e. nodes are labeled E, to indicate if they are empty/unoccupied, F, to indicate full, and P to indicate partially occupied); encoding nodes of the three-dimensional object data (column 3, lines 39-44; column 4, lines 41-65; column 5, lines 11-40, i.e. each block of node packets is encoded and stored in memory as 32-bit words); and generating the three-dimensional object data whose nodes are encoded into a bitstream (Abstract; column 1, lines 35-50; column 9, lines 57-65; columns 10, lines 57-65; column 11, lines 14-28; columns 14-15, lines 43-4, i.e. the 3d object data is generated from the fetched nodes of the octree).

Referring to claim 2, the rationale for claim 1 is incorporated herein, Prevost et al. teaches the method of claim 1 wherein in generating the three-dimensional object data, voxels are differentiated from one another by converting the three-dimensional object

data into voxel data using three-dimensional bounding volume (Figs. 1 and 2(A-D); column 5, lines 41-67, i.e. each 3d object is surrounded by a bounding box comprising the initial object universe and is split into cubes/nodes/voxels such that level 0 of the octree is the root which contains the whole object) and differently labeling the voxels depending on whether or not they are located at places where objects exist (column 3, lines 51-67, i.e. each node/cube is labeled E, empty/unoccupied, F, full, and P, partially occupied).

Referring to claim 6, the rationale for claim 1 is incorporated herein, Prevost et al. teaches the method of claim 1 wherein in encoding the nodes of the three-dimensional object data, all the nodes of the three-dimensional object data are encoded (Figs. 1 and 2(A-D); column 3, lines 51-67, i.e. all nodes are encoded with a label indicating the type, E, empty/unoccupied, F, full, and P, partially occupied).

Referring to claim 30, the rationale for claim 1 is incorporated herein, Prevost et al. teaches a computer-readable recording medium on which a program enabling the method of claim 1 is recorded (column 10, lines 50-65; column 11, lines 19-26; columns 11-12, lines 65-1; column 15, lines 42-47; column 18, lines 27-30; column 19, lines 14-16; column 23, lines 12-20; column 26, lines 9-19 and 49-67, i.e. an apparatus, comprising a geometrical processor and circuitry for performing to functions as described above wherein the functions are programmable is understood to comprise a computer-readable recording medium on which a program is recorded).

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

Claims 7, 16 and 17 are rejected under 35 U.S.C. 102(a) as being anticipated by Samet et al., "Octree Approximation and Compression Methods", Proceedings of First International Symposium on 3D Data Processing Visualization and Transmission, June 2002, IEEE Computer Society, pgs.1-10, hereinafter Samet et al.

Referring to claim 7, Samet et al. teaches a method of encoding three-dimensional object data, which is comprised of point texture data, voxel data, or octree structure data, the method comprising:

(a) generating three-dimensional object data having a tree structure in which nodes are attached labels indicating their types (page 2, section 2 Octree representation, 1st and 2nd paragraphs, i.e. internal/non-leaf nodes are labeled GRAY, occupied nodes are labeled BLACK, and unoccupied nodes are labeled WHITE);

(b) merging the nodes of the three-dimensional object data by referring to their labels (Abstract; page 2, section 2 Octree representation, 2nd paragraph, i.e. each non-leaf/GRAY node is labeled BLACK/GB if at least 4 of its children are black and WHITE/GW if 4 or more of its children are labeled as WHITE or GW thereby merging the children with the parent);

(c) encoding merged nodes (page 5, section 3 Compression, 1st paragraph, i.e. merged nodes are encoded using approximation method);

(d) generating the three-dimensional object data whose merged nodes are encoded into a bitstream (page 1, Abstract; page 1, section 1 Introduction, 1st paragraph; page 2, section 2 Octree representation, 1st paragraph and final paragraph; page 7-8, section 4 Empirical results, 1st and 2nd paragraphs, i.e. 3d binary objects are represented by an octree, and an octree with a maximum depth of 7 is comprised of 128X128X128 voxels/nodes, which are binary encoded as black or white and added to a compressed bitstream thereby generating and transmitting the compressed bitstream data for the 3d object); and

(e) repeatedly carrying out steps (a) through (d) until an uppermost node of the tree structure representing the three-dimensional object data is encoded.

Referring to claim 16, the rationale for claim 7 is incorporated herein, Samet et al. teaches wherein in encoding the nodes of the three-dimensional object data, only some of the nodes of the three-dimensional object data, ranging from a root node to a predetermined lower node, are encoded (pages 2-3, section 2 Octree representation, 3rd and 4th paragraphs; page 5, section 3 Compression, 1st paragraph, i.e. a two-color/binary region octree is defined by enumerating the location codes of either the black or white nodes, the color with the smaller cardinality).

Referring to claim 17, the rationale for claim 7 is incorporated herein, Samet et al. teaches wherein in step (c), all the merged nodes are encoded (page 2, section 2 Octree representation, 2nd paragraph; page 3, section 2.2 Forest-based approximation techniques, 1st, 2nd, and final paragraphs, i.e. each non-leaf node is merged and encoded as GB if at least four of its children are BLACK or GB and encoded as GW

otherwise and then the region octree is compressed using FBW to alternate between the FBB and FWW approximation methods).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 18, 21, 22 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Samet et al. as applied to claim 7 above.

Referring to claim 18, claim 18 is similar in scope to claim 7 and therefore the rationale for the rejection of claim 7 is incorporated herein, Samet et al. recites the elements of claim 7 but does not specifically teach an apparatus comprising a tree structure generator; a merging order selector; a node encoder; and a bitstream generator.

However, Samet et al. does disclose empirical results obtained from experimentation (page 8, section 4 Empirical results, 1st paragraph; page 8, table 2, i.e. results obtained by experiments indicate an apparatus upon which those experiments would have been performed) and therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Samet et al. to include an apparatus comprising a tree structure generator; a merging order selector; a node encoder; and a bitstream generator because a method for

performing the transmission of graphical objects over the Internet with the minimum possible amount of data that is needed to rebuild the original object (page 1, section 1 Introduction, 1st paragraph) would necessarily require the hardware for performing the experiments required to obtain empirical results.

Referring to claim 21, the rationale for claim 18 is incorporated herein, Samet et al. teaches wherein in encoding the nodes of the three-dimensional object data, only some of the nodes of the three-dimensional object data, ranging from a root node to a predetermined lower node, are encoded (pages 2-3, section 2 Octree representation, 3rd and 4th paragraphs; page 5, section 3 Compression, 1st paragraph, i.e. a two-color/binary region octree is defined by enumerating the location codes of either the black or white nodes, the color with the smaller cardinality).

Referring to claim 22, the rationale for claim 18 is incorporated herein, Samet et al. teaches wherein in encoding the nodes of the three-dimensional object data, all of the merged nodes are encoded (Abstract; page 2, section 2 Octree representation, 2nd paragraph, i.e. each non-leaf/GRAY node is labeled BLACK/GB if at least 4 of its children are black and WHITE/GW if 4 or more of its children are labeled as WHITE or GW thereby merging the children with the parent).

Referring to claim 31, claim 31 is similar in scope to claims 7 and 18 and therefore the rationale for the rejection of claims 7 and 18 is incorporated herein, Samet et al. recites the elements of claims 7 and 18 but does not specifically teach a computer-readable recording medium on which a program enabling the method of claim 7 is recorded.

However, Samet et al. does disclose empirical results obtained from experimentation (page 8, section 4 Empirical results, 1st paragraph; page 8, table 2, i.e. results obtained by experiments indicate an apparatus upon which those experiments would have been performed) and therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made that the method of Samet et al. must include an apparatus comprising a computer-readable recording medium on which a program enabling the method of claim 7 is recorded because a method for performing the transmission of graphical objects over the Internet with the minimum possible amount of data that is needed to rebuild the original object (page 1, section 1 Introduction, 1st paragraph) would necessarily require an apparatus and a computer-readable recording medium on which a program enabling the method of claim 7 is recorded in order to perform the experiments required to obtain empirical results.

Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Samet et al. as applied to claim 7 above, and further in view of Moffat, A., "Implementing the PPM data compression scheme", IEEE Transactions on Communications, Volume 38, Issue 11, Nov. 1990, pages 1917-1921, hereinafter Moffat.

Referring to claim 8, the rationale for claim 7 is incorporated herein,Samet et al. teaches the method of claim 7 wherein each internal/GRAY/non-leaf node is merged by counting the number of children/leaf nodes that are BLACK of GB and encoding each merged node as GB if at least 4 of its children are black or GB and GW otherwise (Abstract; page 2, section 2 Octree representation, 2nd paragraph, i.e. the number of

children that are BLACK or GB are counted in a manner similar to the PPM algorithm) but does not specifically teach a node whose voxels are encoded using a prediction-by-partial-matching (PPM) algorithm is labeled 'P'.

Moffat teaches a node whose voxels are encoded using a prediction-by-partial-matching (PPM) algorithm (page 1918, section III. Implementing PPM, 1st paragraph, i.e. each node has a counter that records the number of times a particular symbol, such as GB or GW, has been encountered).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Prevost et al. with the teachings of Samet et al. and Moffat thereby providing a method for performing the transmission of graphical objects over the Internet with the minimum possible amount of data that is needed to rebuild the original object while being able to present the data as soon as possible (Samet et al.: page 1, section 1 Introduction, 1st paragraph) by using the PPM data compression scheme because the adaptive nature of the scheme, and the flexibility afforded by the arithmetic coding, mean that an effective compression scheme will be built for any input file that is reasonably homogenous (Moffat: page 1917, section I. Introduction, 1st paragraph).

Claims 24, 28, and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Prevost et al., as applied to claim 1 above.

Referring to claim 24, the rationale for claim 1 is incorporated herein, Prevost et al. teaches a method of decoding three-dimensional object data, comprising decoding

nodes of a bitstream of encoded three-dimensional object data; and restoring the three-dimensional object data whose nodes are encoded to a tree structure (Abstract; column 1, lines 35-50; column 9, lines 57-65; columns 10, lines 57-65; column 11, lines 14-28; columns 14-15, lines 43-4, i.e. the 3d object data is generated from the fetched nodes of the octree and displayed indicating that the 3d object data is being decoded from the octree into which it is has been previously encoded).

Referring to claim 28, claim 28 is similar in scope to claim 24 and therefore the rationale for the rejection of claim 24 is incorporated herein, Prevost et al. teaches an apparatus comprising a bitstream reader (column 11, lines 29-33); a node decoder (column 11, lines 33-41; column 12, lines 8-27 and 52-64; column 14, lines 3-31); and a tree structure restorer (Fig. 11; column 1, lines 57-62; column 9, lines 57-65; columns 10, lines 50-65; column 11, lines 14-28; columns 14-15, lines 43-4, i.e. an apparatus for performing the method of claim 24 wherein a bitstream of encoded 3d object data is being fetched from memory and decoded and a target tree structure is being determined from the fetched and decoded nodes is understood to be comprised of a bitstream reader; a node decoder; and a tree structure restorer).

Referring to claim 33, the rationale for claim 24 is incorporated herein, Prevost et al. teaches a computer-readable recording medium on which a program enabling the method of claim 24 is recorded (column 10, lines 50-65; column 11, lines 19-26; columns 11-12, lines 65-1; column 15, lines 42-47; column 18, lines 27-30; column 19, lines 14-16; column 23, lines 12-20; column 26, lines 9-19 and 49-67, i.e. an apparatus, comprising a geometrical processor and circuitry for performing to functions as

described above wherein the functions are programmable is understood to comprise a computer-readable recording medium on which a program is recorded).

Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Prevost et al. as applied to claim 1 above, and further in view of Samet et al.

Referring to claim 5, the rationale for claim 1 is incorporated herein, Prevost et al. teaches the method of claim 1 but does not specifically teach wherein in encoding the nodes of the three-dimensional object data, only some of the nodes of the three-dimensional object data, ranging from a root node to a predetermined lower node, are encoded.

Samet et al. teaches this limitation (pages 2-3, section 2 Octree representation, 3rd and 4th paragraphs; page 5, section 3 Compression, 1st paragraph, i.e. a two-color/binary region octree is defined by enumerating the location codes of either the black or white nodes, the color with the smaller cardinality).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Prevost et al. with the teachings of Samet et al. thereby providing a method for performing the transmission of graphical objects over the Internet with the minimum possible amount of data that is needed to rebuild the original object while being able to present the data as soon as possible (page 1, section 1 Introduction, 1st paragraph).

Claims 3, 23, 25 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Prevost et al. as applied to claims 1, 2 and 24 above, and further in view of Samet et al, and Moffat, A., "Implementing the PPM data compression scheme", IEEE Transactions on Communications, Volume 38, Issue 11, Nov. 1990, pages 1917-1921, hereinafter Moffat.

Referring to claim 3, the rationale for claim 2 is incorporated herein, Prevost et al. teaches the method of claim 2 wherein in the tree structure representing the three-dimensional object data, a node having sub-nodes is labeled 'P', a node whose voxels do not contain objects is labeled 'E', a node whose voxels all contain objects is labeled 'F', but does not specifically teach a node whose voxels are encoded using a prediction-by-partial-matching (PPM) algorithm is labeled 'P'.

Samet et al. teaches wherein each internal/GRAY/non-leaf node is merged by counting the number of children/leaf nodes that are BLACK or GB and encoding each merged node as GB if at least 4 of its children are black or GB and GW otherwise (Abstract; page 2, section 2 Octree representation, 2nd paragraph, i.e. the number of children that are BLACK or GB are counted in a manner similar to the PPM algorithm)

Moffat teaches a node whose voxels are encoded using a prediction-by-partial-matching (PPM) algorithm (page 1918, section III. Implementing PPM, 1st paragraph, i.e. each node has a counter that records the number of times a particular symbol, such as GB or GW, has been encountered).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Prevost et al. with the

teachings of Samet et al. and Moffat thereby providing a method for performing the transmission of graphical objects over the Internet with the minimum possible amount of data that is needed to rebuild the original object while being able to present the data as soon as possible (Samet et al.: page 1, section 1 Introduction, 1st paragraph) by using the PPM data compression scheme because the adaptive nature of the scheme, and the flexibility afforded by the arithmetic coding, mean that an effective compression scheme will be built for any input file that is reasonably homogenous (Moffat: page 1917, section I. Introduction, 1st paragraph). Although Prevost et al., Samet et al., and Moffat do not specifically disclose labeling a node containing sub-nodes/children with the label 'S' and labeling a node whose voxels are encoded using a PPM algorithm with the label 'P', it would have been obvious to include the label 'P' for all nodes that have been encoded using PPM and 'S' for all nodes that contain sub-nodes thereby differentiating internal nodes that have been compressed/merged using PPM from internal nodes that have not yet been PPM encoded.

Referring to claim 23, claim 23 is similar in scope to claims 3 and 24 and therefore the rationale for claim 3 is incorporated herein, Prevost et al., as modified above, teaches a method of decoding three-dimensional object data, comprising reading continue flag information from a bitstream of encoded three- dimensional object data and decoding the continue flag information (column 15, lines 24-41, i.e. reading continue flag is the starting status which reads 0 when the level=0, indicating the top of the octree has been reached and nrem=0 indicating that the only transition possible to ending); decoding node type information of the bitstream; decoding an 'S' node if the

node type information indicates that a current node is an 'S' node; and restoring the three-dimensional object data whose nodes are encoded to a tree structure (Abstract; column 1, lines 35-50; column 9, lines 57-65; columns 10, lines 57-65; column 11, lines 14-28; columns 14-15, lines 43-4, i.e. the 3d object data is generated from the fetched nodes of the octree and displayed indicating that the 3d object data is being decoded from the octree into which it is has been previously encoded) but does not specifically teach decoding a PPM node.

Moffat teaches this limitation (page 1917, section I. Introduction, 2nd paragraph; page 1918, section A. Performance of Figures for Methods A and B, 2nd paragraph; page 1920, section D. Tuning for Speed, 3rd paragraph).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Prevost et al. with the teachings of Samet et al. and Moffat thereby providing a method for performing the transmission of graphical objects over the Internet with the minimum possible amount of data that is needed to rebuild the original object while being able to present the data as soon as possible (Samet et al.: page 1, section 1 Introduction, 1st paragraph) by using the PPM data compression scheme because the adaptive nature of the scheme, and the flexibility afforded by the arithmetic coding, mean that an effective compression scheme will be built for any input file that is reasonably homogenous (Moffat: page 1917, section I. Introduction, 1st paragraph). Although Prevost et al., Samet et al., and Moffat do not specifically disclose labeling a node containing sub-nodes/children with the label 'S' and labeling a node whose voxels are encoded using a PPM algorithm with

the label 'P', it would have been obvious to include the label 'P' for all nodes that have been encoded using PPM and 'S' for all nodes that contain sub-nodes thereby differentiating internal nodes that have been compressed/merged using PPM from internal nodes that have not yet been PPM encoded.

Referring to claim 25, claim 25 is similar in scope to claims 23 and 24 and therefore the rationale for the rejection of claims 23 and 24 is incorporated herein.

Referring to claim 32, the rationale for claim 23 is incorporated herein, Prevost et al. teaches a computer-readable recording medium on which a program enabling the method of claim 23 is recorded (column 10, lines 50-65; column 11, lines 19-26; columns 11-12, lines 65-1; column 15, lines 42-47; column 18, lines 27-30; column 19, lines 14-16; column 23, lines 12-20; column 26, lines 9-19 and 49-67, i.e. an apparatus, comprising a geometrical processor and circuitry for performing to functions as described above wherein the functions are programmable is understood to comprise a computer-readable recording medium on which a program is recorded).

Allowable Subject Matter

Claims 4, 9-15, 19-20, 26-27, 29, are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 4, prior art teaches encoding detailed information bit (DIB) data of a node but does not teach encoding detailed information bit (DIB) data of an 'S' node if the node information indicates that the current node is an 'S' node and encoding DIB data of a 'P' node if tie node information indicates that the current node is a 'P' node.

Regarding claims 9 and 19, prior art does not teach selecting, from among the candidate nodes as an optimal node, a node which can minimize a ratio of a difference ΔD between the number of distorted bits before in the candidate nodes and the number of distorted bits after merging the candidate nodes with respect to a difference ΔR between the number of bits before merging the candidate bits and the number of bits after merging the candidate bits; labeling the selected node 'B'; and updating all the candidate nodes except the node selected as an optimal node.

Regarding claim 10, prior art does not teach wherein D is calculated in the following equation using a Hamming distance between an original model V and its approximation *V* as distortion measurement:

$$D = \sum_{x=1}^{X} \sum_{y=1}^{Y} \sum_{z=1}^{Z} \left| V(x, y, z) - \hat{V}(x, y, z) \right|$$

, where XxYxZ represents the resolution of the original model.

Regarding claims 11 and 23, prior art does not teach encoding node type information which indicates whether or not a current node is an 'S' node or a 'P' node; and encoding DIB data of an 'S' node if the node information indicates that the current

node is an 'S' node and encoding DIB data of a 'P' node if the node information indicates that the current node is a 'P' node.

Claims 12-15 are dependent on claim 11 and are therefore objected to as being dependent upon an objected claim.

Regarding claim 26, prior art does not teach wherein in decoding the 'S' node, an average color of eight sub-nodes of the current node is decoded as DIB data, and the eight sub-nodes are sequentially decoded into black nodes ('B' nodes) or white nodes ('W' nodes).

Regarding claim 27, prior art does not teach wherein in decoding the PPM node, the current node is PPM-decoded using DIB data bits (DIB) data, and R, G, and B values of 'B' voxels of the current node are decoded by carrying out inverse AAC and inverse DPCM.

Regarding claim 29, prior art does not teach an 'S' node decoder which decodes an average color of eight sub-nodes of the current node as DIB data and then sequentially decodes the eight sub-nodes into 'B' nodes or 'W' nodes; and a 'P' node decoder which PPM-decodes DIB data of the current node and then decodes R, G, and B values of 'B' voxels of the current node by carrying out inverse AAC and inverse DPCM decoding an 'S' node, if the note type information indicates that a current node is a PPM node.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The following patents and are cited to further show the state of the art with respect to octree and PPM compression.

Meagher U.S. Patent No. 4694404

Dehmlow et al. U.S. Patent No. 5999187

Frisken et al. U.S. Patent No. 6396492

Schwarzer U.S. Patent No. 6429864

Waupotitsch et al. U.S. Patent No. 6518963

Waupotitsch U.S. Patent No. 6529192

De Bonet U.S. Patent No. 6535642

Waupotitsch et al. U.S. Patent No. 6563499

Frisken et al. U.S. Patent No. 6603484

Fujiwara et al. U.S. Patent No. 6914601

Zwern et al. U.S. Patent No. 6999073

The following non-patent literature is cited to further show the state of the art with respect to octree and PPM compression.

Chang et al., “LDI tree: a hierarchical representation for image-based rendering”, *Proc. of 26th Annual Conf. on Computer Graphics and interactive Techniques,* 1999, ACM Press/Addison-Wesley Publishing Co., NY, NY, pages 291-298.

Moffat, A., “Two-level context based compression of binary images”, Data Compression Conference, 1991, DCC '91, 8-11 April 1991, pages 382-391.

Jiangang Duan et al., "Compression of the Layered Depth Image", Proceedings of Data Compression Conference, IEEE Computer Society Press, 2001, pages 331-340.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Roberta Prendergast whose telephone number is (571) 272-7647. The examiner can normally be reached on M-F 7:00-4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ulka Chauhan can be reached on (571) 272-7782. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

RP
3/15/2006

Ulka Chauhan

ULKA CHAUHAN
SUPERVISORY PATENT EXAMINER